EUROPE AND ITS GREEN FUTURE. ELECTRIFICATION AND DECARBONIZATION

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This paper aims to present a great challenge which humanity faces, and which is climate change. Together with food and water shortages which will hit more and more humanity in the years ahead, climate change (which will only amplify these negative facts) will bring negative consequences on economy and society, and in international relations area, too. In this context, the importance of the subject speaks for itself. The research is focused on EU objectives in climate area and in sustainable development, indicating that renewable energy could be a solution for energy independence, and for reducing CO2 concentration level, too.
The subject is very important one nowadays being subject of intense debates and negotiations, having a high degree of visibility in international forums and in international press.
The paper wants to show what EU aims in the future related to its development through fossil fuels consumption reduction and as a base for starting research are researched realized under the aegis of Group Futuribles from Paris, of the National Centre for Sustainable Development from Bucharest, from American Academy of Arts and Science, and International Energy Agency from Paris.
We take from IEA data and present them in the tables in order to have a synthetic view upon energy in EU countries, and of course, there are presented trends in energy consumption in renewable at European level. The development of the subject with the involvements in transport area only brings a fresh air in the debates regarding reducing energy vulnerability together with fighting climate changes.
There are presented some peculiarities of CO2 pollution and their implications, and consequences; and of course, solutions for fighting climate change is part of this presentation. Reducing oil consumption and expanding renewable resources (wind, solar, and hydro) and nuclear energy coupled with the electrification of the economy and transportation sectors, and rising energy efficiency are of outmost importance in fighting climate change. Becoming leader in this area, EU aims not only to promote sustainable development, but to influence in a significant manner the future negotiations in climate area, gaining through this strategy a better position on the world scene.
The added value of our endeavor is in the superposed areas of EU energy independence, freeing transportation sector from the place of being hostage to potential oil crisis in the future, and all of these in the context of fighting climate change. The paper presents how energy independence could be obtained through renewable expansion, while fighting climate change, too.

Keywords: climate change, de-carbonization, electrification, transportation, energy efficiency

JEL Classification: O0, O3, Q4, Q5

Climate change – even if some of us don't think it is real – had already produced some visible effects, and the future, if the appropriate measures wouldn't be taken, reserve very different framework in comparison with which we are accustomed. The burning of fossil fuels (coal, oil and gas) is responsible for green house gas emissions, which bring the temperature's increasing, due to its concentration level's rising in the atmosphere. Nowadays at global level over 4/5 of

energy is produced using fossil fuels (Malița 2009: 296). The industrialization process in last two centuries has put pressure upon Earth's resources and upon environment, nowadays humanity being menaced both by scarcity of resources, and global warming. Between 1900 and 2000 the temperature rose with 0,3-0,6 Celsius degree (Malița1998: 213). Climate change experts concluded that the worst scenario which climate change brings could be avoided if CO2 concentration level would be kept below 550 ppm (parts per million), which means twice the level specific to preindustrial times (Lester and Rosner 2009: 22).

The present CO2 concentration level is 380 ppm, which, together with another 70 ppm CO2 equivalent (resulted from nitrates oxides, and methane) gives a concentration of CO2 equivalent of 450 ppm. The stabilization of CO2 concentration at 450 ppm would bring in the long run a rising temperature by 2 degrees Celsius at global level. The stabilization of CO2 concentration in the 450-550 ppm interval is the main focus of recent political debates, although it is noteworthy to be mentioned that at this level of concentration there would be *significant* economic and ecologic damages (Lester and Rosner 2009: 22).

In this context, EU wants to be a world leader in promoting a de-carbonization of economy and transportation, and rising of energy efficiency. The crisis which become so visible in the summer of 2008 could be regarded as a bell which rang and brought attention that the past and present trend would bring a slow, but a dangerous decline. In a world that rapidly may be nearing its ecological carrying capacity because of growth imperative – which in the past was the main reason for economic and military policies of developed states – there is nearing the day when the national interest will require a different articulation of well-being (Wendt 2007: 236). The role which state is asked to play is greater than in the past decades; the reduced degree of interventionism specific to this period when the neo-liberalism was the main economic doctrine will definitively be replaced by a rising role of the state, (Malița 2010: 29) which will regulate economic activity taking account of sustainable development, providing that kind of development which will bring well-being.

European Commission proposed in 2010 five targets to be reached until 2020, all of them defining the process at EU level and with the obligation of being transposed in national policies, one of them being directly related to *climate change and energy* (Gheorghiu 2010: 118). In 2007 EU adopted a new communal strategy for energy, the objective regarding security of supply being integrated with those related to consolidation of competition on the market and those related to climate changes. Even if after the Kyoto Protocol will expire without a new international accord being implemented, EU assumed *unilateral* measures to be taken: the targets 20-20-20 (Gheorghiu 2010: 121-122). These are: reducing greenhouse gas emissions with 20% in 2020 in comparison with 1990, increasing the share of renewable energy in energetic mix from 7% (2006) to 20% in 2020 in total energy consumption, and rising energy efficiency in order to save 20% of primary energy in EU. It could be noted the role which state is ask to play in order to direct and coordinate national policies for these objective's achievement, its role being felt even in relation with third countries, which don't implement policies which would constrain their economic through pollution taxation. The strategies for achieving this are (Abbas 2009: 53-67): trade liberalization as stimulus for combating climate changes; renegotiating of new accords, taking account of reducing competition in EU countries due to taxes imposed on pollution; derogation from the multilateral norms; and putting in place a mixed governance World Trade Organization – The Climate Change Framework Convention.

What is a focal point regarding energy is the fact that energy security and climate change could push both of them to promote energy efficiency, and de-carbonization of economy. They are expected to encourage the development of renewable energy for electricity in many parts of the world, and as EU wants to be a leader in fighting climate change (being in the same time very vulnerable in energy field), she have to rethink its strategy related to nuclear power. Even with a significant increase of wind and hydro capacities (where there is potential) in EU countries, if nuclear option is not on the decision table, then fighting climate change could be very costly,

even without expected results. Renewable energy sources are quite important for electricity generation worldwide; it amounted to 3470 TWh (2006), or 18% of total output (IEA 2008: 149). In Reference Scenario, it rises to 4970 TWh (2015), and over 7700 TWh (2030), 23% of total electricity production, respectively (IEA 2008: 149).
The most important renewable are wind and hydro power, global output of wind expecting to rise eleven-fold, becoming the second-largest source of renewable electricity after hydro in 2010 (IEA 2008: 159). The *largest increase* is in the EU countries which in 2030 could have a share of wind power in its energy mix of 14%.
In 2006, seven of the top ten wind-power markets in the world are EU members.

Table no. 1. Wind-power in EU countries

Country	Installed capacity (GW)	Wind power production (TWh)	Share of total generation (%)
Germany	20,6	30,7	4,9
Spain	11,6	23	7,7
Denmark	3,1	6,1	13,4
Italy	2,1	3	1
United Kingdom	2	4,2	1,1
Portugal	1,7	2,9	6
France	1,6	2,2	0,4

World Energy Outlook 2008, IEA

There is potential for expanding this kind of energy in EU countries, especially in UK (which has the greatest potential), and France (which has the second potential in EU) (Florian et Temime 2008: 27). And this could be reached following a policy of encouragement from *states*; indeed, this is the case: the price of wind electricity is sustained in numerous countries through a tariff policy aimed at the development of renewable energies (Florian et Temime 2008: 31).
Hydropower is the world's largest renewable source of electricity, generating 3035 TWh (2006), around 16% of total electricity (IEA 2008: 402).
But there must be understood that the force of atoms could help generate energy in a clean manner, and together with renewable energy, to promote the increase of energy security through the development of alternative sources of energy, and decrease the concentration of CO2 due to energy production.
In the nuclear field, EU countries are important players, one of them implementing the most successful nuclear program in the world – France. The potential of nuclear expansion in EU countries is quite large, but its expansion could head the opposition coming from different groups and institutions.
It is noteworthy to be mentioned that European countries depend nowadays in great part (some of them almost totally) on energy imported from other countries; the shift to nuclear, and other renewable resources could help them in mitigating climate change, in rising their energy security, and in promoting a better position in global negotiations regarding climate change. The European countries dependence on imported Russian gas is a hindrance in promoting a cohesive energy policy in EU at large, situation which is exploited with great success by Moscow through its giant arm – Gazprom. The dependence of European countries on Russian gas is presented in the following table (Table no. 2):

Table no. 2. European countries dependence on Russian gas

Country	Energy which is based on imported naturas gas (%)
Bulgaria	100%
Slovakia	100%
Finland	100%
Estonia	100%
Letonia	100%
Lithuania	100%
Greece	84%
Austria	78%
Hungary	77%
Czech Republic	75%
Poland	63%
Romania	63%
Slovenia	51%
Germany	32%
Italy	32%
France	23%
The Netherlands	17%
Switzerland	13%

Eni S.p.A., World Oil and Gas Review, 2006

Anyway, the review made in *Germany* (and in other EU countries which after 1979 started to view nuclear energy with skepticism) regarding nuclear energy field in last years (but before March 2011) can be regarded as a positive mark related to nuclear energy renaissance in EU countries.

The present state of nuclear energy in EU countries is presented in the following table (Table no. 3).

Table no. 3. Situation of nuclear generating capacity and reactors in EU member countries

Country	Number of reactors	Installed nuclear capacity (MW)	Share of nuclear capacity installed in total at global level (%)
France	58	63130	17,05
Germany	17	20480	5,53
Sweden	10	8992	2,43
Spain	8	7450	2,01
Belgium	7	5863	1,58
Czech Republic	6	3678	0,99
Finland	4	2696	0,72
Hungary	4	1889	0,51
Slovakia	4	1762	0,47
Bulgaria	2	1906	0,52
Romania	2	1300	0,35
The Netherlands	1	482	0,13
Slovenia	1	666	0,18

IAEA, Nucelar Power Plants Information (Number of Reactors in Operation Worldwide) http://www.iaea.org/cgi-bin/db.page.pl/pris.oprconst.htm, (vizited February 7, 2010);

IAEA, Power Reactor Information System http://www.iaea.or.at/programmes/a2/, (vizited February 7, 2010)

Furthermore, there are in diverse construction phase six nuclear reactors in EU four member countries, the situation being detailed in (Table no. 4).

Table No. 4. Situation of nuclear power plants under construction in EU member countries

Country	Number of reactors	Nuclear capacity under construction (MW)
Bulgaria	2	1906
Finland	1	1600
France	1	1600
Slovakia	2	810

IAEA, Nuclear Power Plants Information (Under Construction Reactors by Country), http://www.iaea.or.at/programmes/a2/, (vizited February 7, 2010)

But as we can easy note, all these measures mean economy's de-carbonization, and electrification, too. This action will have a profound impact at economic, social, political, and environmental level. In all these fields, the implications are many: reducing energy vulnerability in a historical context in which the hungry for resources will be more and more acute (especially due to the rise of China and India, and due to population's number rising at global level); EU economy's de-carbonization and electrification means a greater energy independence, a vital aspect for national power, with ramifications in the currency area (for a country to have a strong currency, it needs energy independence).

Another area with high impact at economic, social, and political levels is transportation. Transportation's de-carbonization means not only the reduction of consumption of oil, improving energy independence of EU economies, but reducing the CO2 emissions from transportation sector. The climate change accuses the pollution resulted from fuel consumption in transportation as a factor which hurts a lot the environment; in fact, at EU level, over 50% of oil consumption is due to private cars, while some 30% of CO2 emissions in Europe is due to transportation, 84% of which is due to road transport. The de-carbonization of transportation sector means first and foremost that there must be developed new types of transport, while the internal combustion engine losing its primacy. This means a coherent policy at EU level in both areas: in *energy*, and *transportation*.

But these two elements are of outmost importance on each state's agenda in the modern and post-modern worlds. Energy independence means a greater flexibility in foreign policy, and reducing transportation's dependence on fossil fuels only amplifies this aspect: is case of international crises which involves interruption of energy flow, the movements of people and goods is provided by means of transport which aren't based on oil consumption; and in this way there is present a greater independence in mobility, element with strategic implication.

There are three major directions of action in the fields of energy and transportation. As energy production will become cleaner, the electrification of transportation sector is a natural and direct consequence of this. In this way, new investments in clean energy sector can provide a stimulus for overcome present financial crises, these being simultaneously solutions for solving energy, and environmental crises. Rising the part of energy produced in a clean manner (solar, wind, hydro, and nuclear) while reducing fossil fuel consumption in nothing else than heading to sustainable development. Now, at EU level, the directions for transport de-carbonization are:

- in order to create mobility on medium and long distances the development of railways fitted for *high speed trains* is the best solution for decongestion of already crowded European highways, skies, and airports, saving simultaneously time, energy, and lowering pollution level;
- in order to create mobility on shorter distances the development of electric engines for cars is a solution which involves only reduction of oil consumption in transport, but if this is coupled with;
- the development of clean public means of transport such as tramways, bicycles, and metros (these especially in great urban concentration) coupled with reducing the number of autos, this will contribute to transport fluidization in urban areas, reducing noise, and pollution.

All these three direction have chances of success (there are already numerous examples in Western Europe cities, regions and countries), and this direction will make EU a good example of society which embraces sustainable development. It will be solved simultaneously the problem of crowded highways and airports without affecting mobility, there will be reduced pollution, noise, and the number of car accidents (already car since it was invented had killed more people than both world wars combined (Giddens 2009: 161)), and oil dependence will be attenuated, rising foreign policy independence, and the importance of EU on world stage, due to this reason, and in the climate change negotiations, too.
In this way, EU will obtain benefits internally through sustainable development, and externally, becoming the global leader in sustainable development and in climate negotiations, gaining for it a better position on world stage.

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